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A TREATISE

ON

C

SHIP DRAUGHTING.

by Wm Laister

A PLAIN STATEMENT

OF THE

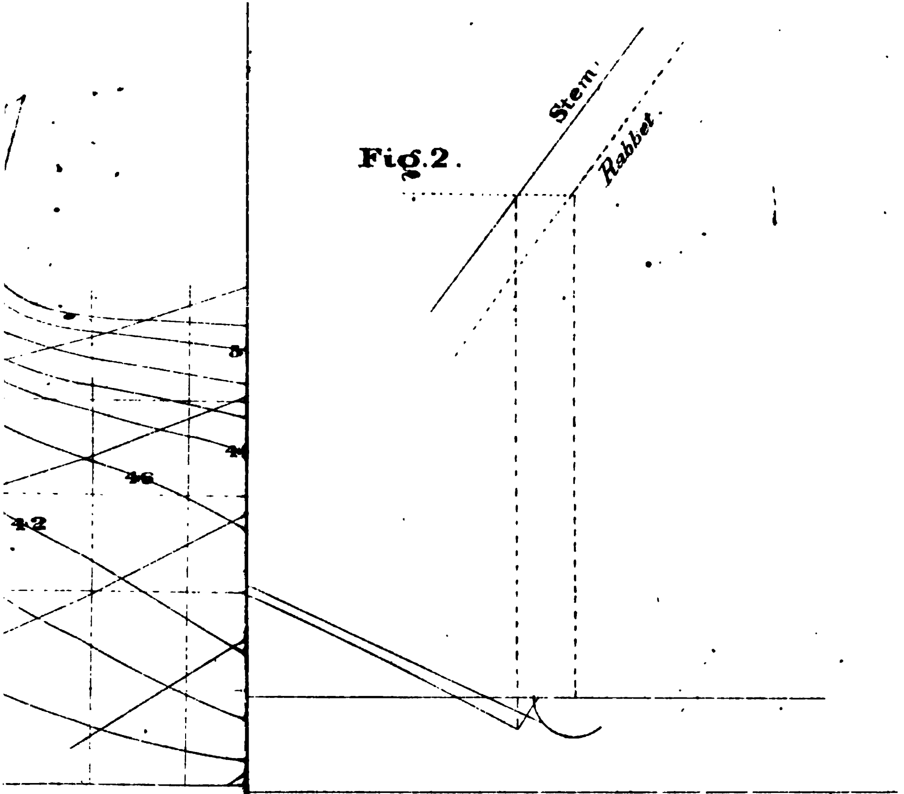
PROCESS OF DELINEATING

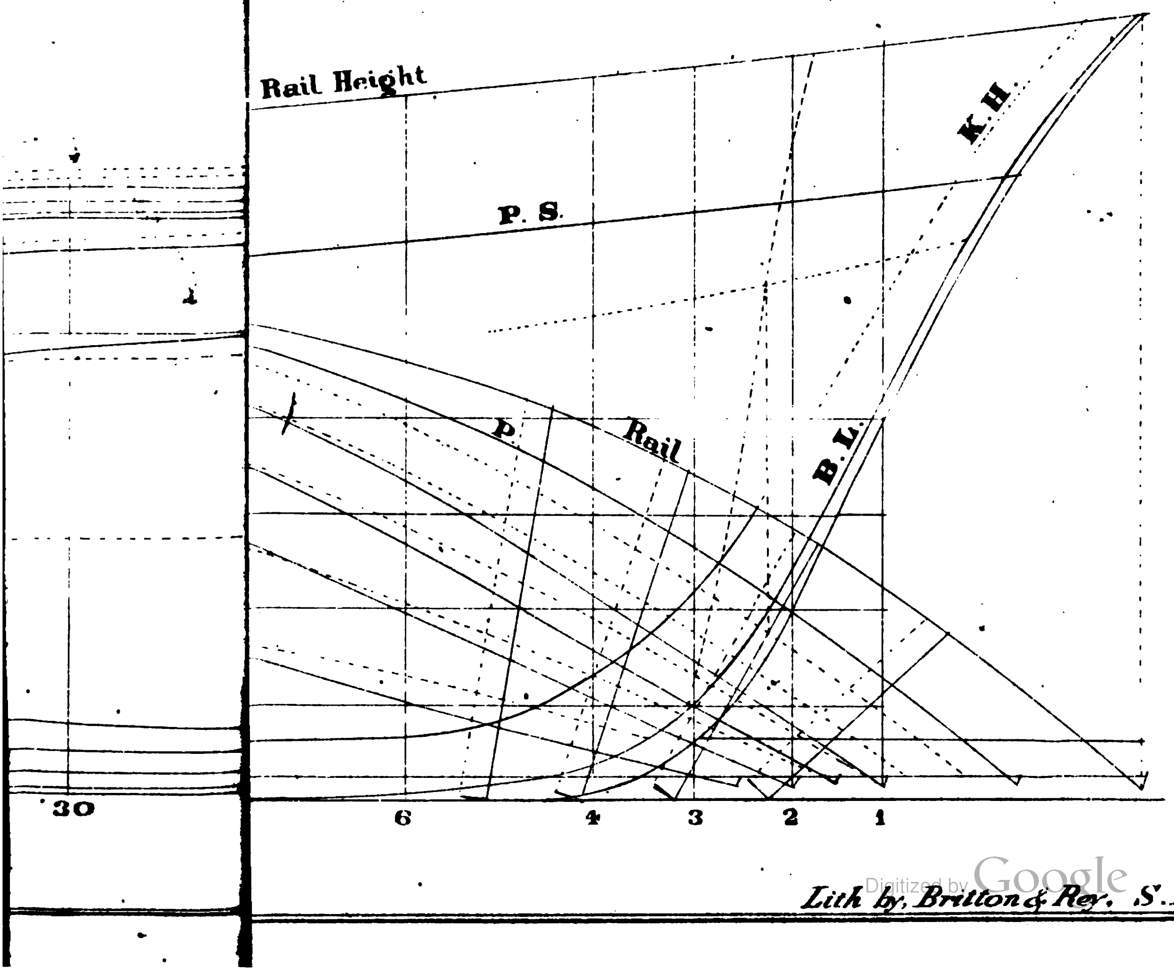
THE

LINES OF A VESSEL

ON A FLOOR.

Fig. 2.





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A TREATISE

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A PLAIN STATEMENT

OF THE

PROCESS OF DELINEATING

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LINES OF A VESSEL

ON A FLOOR.

By [illegible]

SAN FRANCISCO:
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INTRODUCTION.

The following pages are offered to young ship builders, as a plain statement of the process of ship drafting. The writer believes it to be well adapted to, and it is intended for, those who have not had an opportunity of learning the method of defining the lines of a vessel on a floor. Some works have been written on the subject that are so full of scientific terms and matters foreign to the subject, that they perplex rather than instruct, and are of little use to those who do not already understand it, more or less. If a person who has a knowledge of ship drafting attempts to read an English work on the subject which was written twenty years ago, with its calculations and formulas, he is brought to a stand, and wonders why such books are written. The intention of the writer has been to write a book on ship drafting which every shipwright can understand; and whatever may be its merits or defects, it will no doubt be appreciated at its true value.

WM. LAISTER.

SAN FRANCISCO, CAL., 1866.

TREATISE ON SHIP DRAUGHTING.

THE MODEL.

When a vessel is to be built, and the principal dimensions, the length, width and depth are determined on, the first thing to be done is to make a model.

Models are so common at the present day that any description of them might be deemed unnecessary; but to a person about to make his first one, a few words may not be out of place. Models are always made on a scale, generally from a quarter to a half-inch to the foot, of two different kinds and opposite colors of well seasoned soft wood—as pine and black walnut, or cedar—laid up alternately and keyed or screwed together. The lower or parallel lines are called water lines, the piece that is swept to a curve is called the plankshear height, and the piece at the top is the rail height. One half of the vessel only is made, usually the right half. In plate 1, are the lines of a vessel 100 feet long on the fourth water line, 24½ feet wide, and 9 feet deep, on ¼ inch scale to the foot. In a model the outside planking is deducted from the breadth. To get the depth of model required for a vessel 9 feet deep, write down say 9½ inches for depth of floor, 2½ say for thickness of ceiling; add 9 feet less the crown; the beam, say 5 inches, gives 9 ft. 7 in. for the required depth of model, to the plankshear height, if we have no water ways. In large vessels the water lines are usually two feet apart; but for a vessel the size of the one in the first plate, eighteen inches would be more suitable. The principle or method of drafting can be illustrated as well with four water lines as more, as in the plate; a multiplicity of lines only creates confusion.

Draw a side view of the model on a smooth board before you begin to make it. First draw a base line near the lower edge, and working from a scale get the length; set up from the base the depth of model at the lowest point in the plankshear, and the height of the stem and stern; bend a batten through the points to the required curve, and mark in. A line parallel with this, and the height of the stanchion above it will be the rail height; mark in the stem and stern post, and the height of the cross seam (which is the transom), and taking care to leave room for the stern post and rudder mark in the rake of the counter; draw parallel waterlines the distance you want them apart. It is well to have a water line at the height of the cross beam. Square up from the base line the dead flat or widest frame at the point you want it. Having now the heights of the plankshear and rail, we may mark in a dead flat frame in a body plan. First draw a base line, and erect a perpendicular; draw parallel lines on each side of it, half the width of the keel from it; draw parallel lines at the height of the plankshear and rail, and having determined on the dead rise and tumble in of the rail, mark in the dead flat frame. Fit a piece of thin material to the outside of it, to be applied to the dead flat in making the model.

Having put the model together, and faced it true, we may cut off the ends a fraction longer than the required length, as the ends are liable to be bruised in making it. Gauge a line on the bottom for the half breadth of the keel, plane of the dead rise, and if we have decided on the fulness of the bow and the width of the stern at the rail height, we can bend a batten to the rail breadth, mark it, and cut off all surplus wood there at once. Apply the mould at the dead flat frame and cut off the surplus wood there also. A drawing knife, plane, spokeshave, gouge, a course, and a fine wood rasp, with our own taste and skill, will complete the model, but before we finish it we must take it apart and examine each piece separately, for although it is made of two kinds of wood, to assist the eye in detecting any irregularities in the lines, the most practised eye will detect them better when taken apart. Sailors and other amateurs, in model making from a block of wood, always have more or less a flat place on the broadside.

The model being completed, we may draw lines across it for the taking off of the half breadths at every fourth frame and toward the end of every alternate frame, commencing at the dead flat, or we may transfer our half breadths to the board by taking the model apart and placing the dead flat of each piece to the point on the base line ; mark round it with a fine pointed pencil—and on each frame its number.

The following form will answer for a table of dimensions :

Frames. No.	Plankshear Heights. ft. in.	1 W. Line. Breadths. ft. in.	2 W. Line. Breadths. ft. in.	3 W. Line. Breadths. ft. in.	4 W. Line. Breadths. ft. in.	Plankshear Breadths. ft. in.	Rail Br'dths. ft. in.
1							
2							
4							
6							
8							
10							
14							
18 &c							

Stem forward of frame No. 3.
Rail aft of frame, No. 51.
Knuckle height.

Heel of stern post forward of frame No. 51.
Knuckle aft of frame No. 51.

On the floor we need some long battens, say an inch square ; a few shorter ones for the half breadths and diagonals, and several long and small enough to bend to the frames—say three-eighths by half an inch. It will be necessary to make some of these thinner where there is a quick curve.

The first thing to be done on the floor is to draw a straight line the whole length of it a few inches from the most convenient side, to which nail straight strips of boards. This is the base line ; it is the top of the keel for the side plan or shear plan—it might be called the side view plan. It is also the centre of the vessel in the half breadth plan. At right angles from this line strike in all the frame lines at the distance they are apart. As all straight lines on the floor are chalk lines, they get trodden out ; we must therefore make a permanent mark at each end of a line, so that we can always find the spot if we want to brighten it. Leave sufficient room at the end of the floor to make the stem mould, which is made to the outside of the stem line. Number the frames you have in your tables, and mark in on the floor all the plankshear heights, on their respective frames, for several frames aft of the dead flat. All settings off on the floor are marked with a scratch-awl, and roughly marked with chalk, so that they may be readily found. A batten is applied to these points in the same way as is done in the shipyard whenever there is a curve too acute to spring a line on. It is, in fact, passing a true curve through somewhat irregular points. The process is simple, and need not be referred to again—drive a nail at each point deep enough to hold the spring of the batten, apply a batten to the lower side, and pressing the batten close to each nail drive another nail opposite. Butt on other battens till you get the required length. As it is difficult to expand dimensions quite correctly from a quarter of an inch to a foot, it is very likely there will be a number of kinks in the batten. By pulling out a nail here and there, the batten itself (away from the butts) will do much toward making a true curve. Having regulated the batten to the best of our ability, keeping to the points as near as possible, mark well in with a stout pencil. Raising up the batten the length of the stanchion, and marking in will give the rail height. We can now strike in our water lines, which are two feet apart, and mark in the stem. The table gives us the distance on each line forward of frame No. 3, but as we have no point to guide us below the first water line, we must run it into the base line by the eye; and after having faired the batten, mark in the stem. The writer is aware that this detail will be deemed unnecessary by some, but this is written for those, who are unacquainted with the routine of the floor, which, however, is no small part of the knowledge of ship-drafting

ENDING OF THE WATER LINES.

We can now run in the rail half breadth from the tables. It may be necessary to make alterations in the lines below, but this line once in, will not be altered. First draw a side line half the width of the keel from the centre line. It is also the half stem line at and forward of where the stem rests on the keel. To get the ending of the rail breadth, square down the point where the rail height cuts the stem to the side line, for it is evident that the rail must be of the same length in each plan. They are, in fact, the same line seen from a different stand-point. Having set off all the rail half breadths from the tables, apply a batten. Take a square, or what is better, a strip of board the width that the planking is to be thick at the stem; the end of the board being squared, apply it to the outside of the batten so that the outer corner is on the side line, and the inner corner is on the line we have just squared down. Hold it temporarily in its place till the batten is regulated and marked in. Mark also the end of the board; it will show the depth of the rabbet and the amount of wood to be beaded off the stem.

ENDING WATER LINES ON A RABBET

Is another way of ending: Draw a line the thickness of the planking outside of the stem, square down to the side line, and with a pair of dividers set to the thickness of the planking sweep a quarter circle for the line to end on. The difference in the two systems is this—in one case the seam between the stem and apron is the inside of the rabbet, in the other instance the outside of the rabbet is the thickness of the planking forward of the apron. In one instance the outside of the rabbet is cut to suit the inside; in the other, the inside of the rabbet is made to suit the outside. The philosophy of ending on a rabbet is to keep the inside of the rabbet always forward of the seam between the apron and stem, so that in caulking the oakum may not be driven into the seam. [See plate 1, Fig. 2.]

BODY PLAN.

It is necessary for a person who undertakes to learn ship-drafting to have it well fixed in his mind, before he goes any further, the difference between breadths and heights. The lines of the two plans are intermixed on the floor, and it is in squaring up and down the points and transfering heights and breadths to the body plan, and regulating them to true curves that agree with each other, that ship-drafting consists.

We may now make a body plan and mark in our dead flat frame on each side. The rail breadth and the plank-shear and rail heights we must take from the floor. The tables will give us the rest of the breadths ; the process we have already gone through in making the model. Next transfer all the heights from the shear plan to the body plan, marking all the heights on the side line and again at a point outside of the dead flat. Snap a line across at each height—for at present we do not know the exact point in the line that we want—and number them (see the plate). Take a pair of dividers set to the thickness of the planking, set one leg at the intersection of the base and side line, and the other leg on the side line below the base ; and making the lower leg the pivot, sweep a quarter circle ; all the frame lines in the body that come down to the keel end on this circle, consequently the frame lines will rise higher on the side line the further we get forward. We must take extra care in running in the dead flat frame, as it is a starting point, and once run in is not to be altered. We now take our tables and measuring from the centre line in the body plan, mark in all the half breadths at their corresponding heights, and then commencing next to the dead flat apply a batten and mark in each frame with a thin piece of white or French chalk. If when a batten is applied to the points it does not form a true curve, we must examine the distances apart of the points, for it is in the nature of a curve that the points gradually increase their distances, and we can form an idea where it is that we have made a slight error in taking the breadths off the model. In a ship-loft where there are plenty of battens and practised draftsmen, a batten is bent to each frame and not taken up till they are proved and marked in ; but were a new beginner to attempt this he would hardly succeed. Those frames that cross the stem must have their heights set up on the side line in the body plan, and ended on a sweep as below. Having run in all the frames in the body plan, we must prove their correctness by transfering them to the half breadth plan, and regulate them to a true curve, as we have already done by the rail breadth. We shall be very likely to discover some irregularities in the body plan, and we must go back to the body plan and make the necessary corrections.

THE BEARDING LINE

Is the line that shows the point to commence at in bedding the planking into the apron so that the planking will butt against the stem. It is got by squareing up the points where the half breadth lines cross the side line to their corresponding heights in the shear plan, and in order to continue the line further aft, take the heights in the body plan where the frame lines cut the side line, and apply to their respective frames in the shear plan, where the bearding loses itself in the base line.

THE DIAGONAL LINES

Are struck into the body plan at the points where it is required to have a bevel. There should not be less than five in a vessel the size of the one in the plate. The first should be about half way between the keel and the end of the floor, the second near the end of the floor, a third at the centre of the bilge, a fourth at the top of the second futtock, and a fifth between that and the plankshear. They should be about equal distances apart at the side line, as it is from them that the widths of the moulds are taken. The diagonals are usually measured from the centre on the rake of the diagonals, and run in the half breadth the same as water lines. To end a diagonal, take the height where it crosses the side line in the body plan, and apply it to the bearding line, which point square down to the side line. But as the diagonal crosses the side line on a rake in the body plan, we must set up that distance from the base line in the half breadth. The diagonals are dotted lines in the plate. This kind of diagonal is called the extended diagonal. Some good draftsmen take off the diagonal on a parallel—that is, to the nearest point in the centre line. It does not however make so reliable a line in those diagonals that are below the bilge. The chief irregularities to be corrected in the diagonals will be below the first water line ; for in running the frame line into the body plan we have no guide but the eye below that point. When we have made the lines in the body plan agree with the diagonals and water lines, and they show a fair and true curve, our work is proved. We may pass a curve through the rail and shear heights in the body plan, and mark in our frame, water, and diagonal lines with a stout pencil. Run in every frame in the fore body except the forward frames, whose place is to be supplied by cants;—we needed them to fair the lines by—they are now no farther use.

CANTS.

Draw a line parallel to the side line in the half breadth plan the width of the knighthead from it, and divide off the spaces for the cants between the knighthead and forward square frame on the rail breadth, and strike in the cants. The point where the cants cross the side line is squared up to the bearding line, and this is the point fore and aft for the cants on the deadwood. The point where it cuts the bearding is the height of the heel of the cant in the body plan, but as the distance between the side and centre line is increased by the rake of the cant. That distance must be applied in the body plan and a new side line drawn, which is the cut off of the cant (see the plate). [The height of the cants on the deadwood is got by drawing a line across the cant mould, at the height of one of the water lines. It is called the standing mark. The water lines are drawn on the side of the deadwood, and the standing marks are placed to their corresponding water lines.] The cant heights on the rail and plankshear are got by squaring up their half breadths to their shear heights; the cants are run into the body plan the same as square frames, measuring the widths on the rake of the cant. In the plate a separate cant plan is made, to avoid the mixing up of so many lines. Diagonal breadths are sometimes taken from the body plan on a parallel to the water lines, instead of being taken on the rake of the diagonal, in order that the diagonals may be applied the more readily to cants. But there is a way by which the extended diagonal may be applied, as follows: Take the heights from the base line in the body plan, where the diagonal lines cross the frame lines, and set them up in the shear plan ; this is the diagonal height. Then square up the cant from the half breadth to the shear plan by squaring up the points where the cant crosses the half breadths to their corresponding heights ; take the height where the squared up cant crosses the diagonal height, and set it up in the body plan, draw a parallel line (see the plate). Now go back to the crossing in the shear plan and square down to the diagonal breadth. The distance from the centre line of the cant to this point is applied in the body plan to the centre line of the diagonal, and to the height of the parallel line.

When diagonal breadths are taken square from the centre line, this same parallel line has to be got, but the process is different. The point where the cant crosses the diagonal in the half breadth is taken on a square from the centre and applied on a square to the diagonal in the body plan, which will give the height of the parallel line, and the distance along the cant in the half breadth is applied on a square from the centre line. Diagonals, however, are not generally applied to cants ; water lines only are used at the bow, and water and section lines at the stern. If we want a point above the upper water line, we can draw a new water line in the body plan, transfer it to the half breadth. and use it instead of a diagonal.

BEVEL OF FRAMES.

Just so much as the frame lines are apart in the body plan is the amount of bevel in the distance that the frames are apart in the vessel. If the frames in a vessel are two feet apart, take two parallel strips of board, say six feet long and two inches wide, tack them to the floor twenty-two inches apart, run a gauge line on each, making the gauge lines two feet apart, draw a line square across them near the centre, take a piece of batten to the body plan, commencing on the first diagonal at the forward square frame ; mark the distance to the next frame outside—not on the rake of the diagonal, but to the nearest point—having marked all the distances and their numbers, apply the end of the batten to the line squared across at the gauge line, and transfer the distances and numbers; draw lines across from the opposite gauged and squared lines with a straight edge to each number, and across the bevel board. This, however, is a fraction less than the true bevel; to get the bevel of frame ten, for instance, quite correct, it is necessary to take the distance between frames nine and eleven, and divide it.

CANT BEVELS.

To get the bevel of a cant, strike a line parallel to, and the thickness of the timber, say six inches from it; square the heel of the cant from the centre line, apply a batten to the point squared to, instead of the centre, and take off the breadths as though it was a cant, and run it into the body plan. The distance between this line and the cant is the amount of bevel in six inches—where the line falls inside, it is an under bevel; if outside, a standing one. A line squared across a board six inches wide, and the distance set off on one edge that the lines are apart, and a line drawn across from the settings off to the squared line at the other edge, will give the bevel. The bevel of the heel of the cant is got by applying a bevel to the centre line in the half breadth plan, to the rake of the cant. We can judge of the amount of bevel of a cant by the angle that it cuts the lines in the half breadths; the same principle will apply to any other part of the vessel.

KNIGHTHEADS AND APRON.

It has already been said that the width of the knighthead is parallel to and outside of the side line in the half breadth plan. To get the outer or beveling edge, square it up to the shear plan—a line passed through the points will show the shape of the outer side—the inner or moulded side is the bearding line, and the distance between the two lines is the amount of bevel in the width of the knighthead. In the half breadth, a line squared up from where the forward cant cuts the side line shows the cut off of the heel of the knighthead, as frame 2, in the plate; and the bevel of the heel is the rake of the forward cant. If the apron is wider than the stem a new side line—the apron side line—must be struck in and squared up ; this will give a separate bearding for the apron. The wider the apron, the further aft the bearding will necessarily be. If the apron is not wide enough for the size of the bowsprit, a filling-in piece is necessary to spread the knightheads. Whatever may be the thickness of these pieces, they must be struck in the half breadth ; squaring up into the shear plan will give their shape and bevel. The bevel of the knighthead is sometimes taken from the half breadth by applying a bevel to the side line. This, to be quite correct, would have to be applied on parallel lines drawn at the rail and shear heights, and not on the rake of the plankshear and rail. The knighthead mould will, of necessity, be wider in consequence of the bevel. If the top of the stanchions of the vessel in the plate be four and one-half inches, the mould of the knighthead at the top of the stanchion would require to be six and a half inches wide. Lines drawn the width of the moulding size of the stanchion, lengthwise on the bevel board, show the required increase of breadth, if measured on the rake of the bevels.

HARPENS.

In a large vessel there are usually three—rail, plankshear and a harpen at one of the upper water lines ; the mould is necessarily made to the outside of the half breadths, and long enough to reach to two or three of the square frames ; their only use is to place the cants, and hold them temporarily ; lines are drawn across them on the rake of the cant. A bevel applied to the heights in the body plan, and down the cants, gives the bevel, which must be applied on the lines drawn. But in a mould made to the half breadths there is no allowance for rise and curve. To make a harpen quite correct, square up the cants on the rail breadths to the rail heights, draw a perpendicular from the rail bearding to the side line, apply the end of a batten to the line and along the section lines on the shear plan, and mark the cants we have squared up and two or three of the square frames ; carry the batten down to the half breadths, and keeping the end to the perpendicular line, the batten will show the distance that the half breadths must be moved aft. We can, if we choose, run in a line from which we can apply the bevels square, draw a line say four inches below the heights in the body plan, set off the breadths in the half breadth plan, and pass a curve through the points. The distance that these lines will be inside of the breadths will be the amount of bevel in four inches.

AFTER BODY.

We may now take the other end of the floor, and leaving room for the rake of the counter, number the frames. If the floor is twelve or fifteen feet longer than half the length of the vessel, it is as long as is required ; if it is not it will be necessary to lay down the vessel in three lengths, in order that there may be a lap by of the battens. The tables give us the height of the cross seam on frame fifty-one, which is the transom ; and also the distance forward of it, for the heel of the stern-post ; and the height and distance aft, for the knuckle and top of the counter. The lines are squared down for their ending on the side line the same as on the stem, except the diagonals which cross frame fifty-one ; these are set up on frame fifty-one. If we are cramped for room on the floor, we can strike in all the square frames say six inches apart instead of two feet ; this will answer the purpose of regulating the frames, except at the ends of the vessel.

SECTIONAL LINES AND SECTION SPOTTING.

Section lines are struck in perpendicularly in the body plan the same distance apart as the water lines and consequently the same parallel lines that are water lines in the shear plan are also section lines in the half breadth. In order to get the height of the section lines on frame fifty-one, take the piece of the model that forms the plankshear, the lower side of which is the fourth water line, and run gauge lines on it for the sections the same distance apart as the water lines. Square a line across it at frame fifty-one on the lower side, and applying a straight-edge to each section, get the heights above the fourth water line. The distance that the knuckle is aft of frame fifty-one at each section, is got in the same way. Having run in the rail and shear heights and rail breadths, making them to compare with the fore body, we may run in frame fifty-one, making it a permanent frame not to be altered, if we choose to do so, and having run in the frames in the after body plan and corrected them by the half breadths and by diagonals, we may try them by sections. The section lines are struck in the body plan and run into the shear plan by taking the heights where they cross the frame lines. If frame fifty-one is a permanent frame, the section line run out fair will show the height of the knuckle, squared up from the knuckle length, and may be run into the body plan. As the water and section lines are the same distance apart. the first water line and first section will cross each other at the first water line height, which is also the first section breadth (see the plate where a circle is drawn round the crossing). Where the half breadth first water line crosses the fourth section, for instance, that point squared down to the first water line, is the point for the first section line to cross, the same as is done in all the other crossings, giving us four points on each water line. This line when run in is the straight section seen from a different stand-point; if this is not understood, draw lines parallel with the keel on the lower side of the model, the same distance apart as the water lines are, and taking a half breadth view of the crossings, turn the model slowly to a side view; the section line must agree with these crossings or the work is not correct (see the plate).

There is a way by which frame lines may be proved by sections from the first, but it requires a number of battens, as they cross each other. making it difficult to hold them to their place. Instead of the body plan take the half breadth plan for the settings off, and having made fair water lines, square up the section spots and apply battens to the points. These will cross the battens that are on the water lines—if we had six water lines there would be as many points on each water line to regulate the batten to between the dead flat and transom; being regulated to agree, it is impossible for the frame lines not to be correct, if at the same time there are a few battens bent to frames in the body plan. This plan almost dispenses with the diagonal, as some draftsmen do, while others believe them to be, in consequence of running nearly in the direction of the planking, to be the best line. The best line, however, is that which crosses the frames nearest at right angles.

SECTION SPOTTING CANTS.

The difference in laying down the fore and after cants is in section spotting the latter. As the cants are not at right angles, and at different angles, it follows that the width of the sections vary in the body plan, at each section and each cant; the width of the section spots in the body plan is got by taking the width of the sections on the rake of the cant, and the height is got by squaring up those crossings to their sections in the shear plan. In a vessel like the one in the plate, it would perhaps be advisable to have another section run in to section spot the cants farther out. If we mistrust the correctness of any point, we can run in a short line to prove it. In the plate the first cant only is squared up into the shear plan; this is not necessary on the floor. It passes through the heights of the sections, and shows the points that would be used in section spotting the cant.

THE STERN FRAME

Is adapted to full vessels, for the transoms only extend from the bearding line to the fashion piece or after cant. In drawing parallel lines across the body plan and stern post for the height of the transoms, the lower side of the main transom must be a few inches below the cross seam, or there would be no boveling wood. Take the breadths from the body plan where they cross the frames and run them into the half breadth plan as though they were water lines—as in fact they are—so that if the transoms come at the water lines, we have the lines already. Where the transoms cross the sections in the shear plan, square down to the sections in the half breadth for the point where the transoms will cross, square down their crossings of the bearding for the ending of the lines; the after cant or fashion piece shows the cut off of the ends of the transoms; up and down they are cut square. Strike a line for the width of the main transom forward of frame fifty-one; the outer end shows how much is sniped off, so that there will be solid wood where the fashion piece is bolted to it. The main transom rests on the inner post; the rest of the transoms are let into the inner post as far aft as the bearding. The mould of frame fifty-one, moulds the after side of the transom, and the section lines are drawn across it, to which the bevel is applied. The bevels are got by applying a bevel on frame fifty-one in the shear plan and down the sections. All the transom moulds, except the main, are made to their lines in the half breadth plan, and the section lines drawn across; at which angle the bevel must be applied. The bevels are got by applying a bevel to the transom heights that cross the stern post and down the sections. It is customary in large vessels to run in a line both for the upper and lower side of each transom and make a mould for each

STERN POST.

In large vessels the stern post is made wider at the cross seam than at the heel, in order to make room for the rudder. This width must be struck in the body plan; it will cause a new and separate side line for each of the water lines in the half breadths. There will also be two bearding lines, for although the stern post is wider above the keel, the dead wood, which receives the heel of the cants, is not. It has already been shown that one bearding is got by squaring up from the keel line; the post bearding is got by squaring up the new side lines. A mould may be made for the forward side of the inner post by taking a board the width of the stern post drawing lines across at the height of the water lines, and working from a centre line, set off on each side the distance from the centre to the water lines at the point which is the forward side of the inner post. If the inner post is a foot deep fore and aft, one foot from the ending of the water lines will be the point. In centre-board vessels and flat bottomed river steamers, the keel generally narrows at each end; whatever may be the width of the keel, it is shown by the side line in the half breadth, and that portion of it which is not parallel to the centre line will have a new and separate side line, and ending at each frame in the body plan.

THE COUNTER TIMBERS

In the plate are a continuation of the section lines, and would not be in their proper places, as the two centre counter timbers are bolted on each side of the stern post, and down to the bearding. They are struck into the half breadth and body plans. The heights on the transom or frame fifty-one are taken from the body plan and set up in the shear plan, and the knuckle and rail breadths squared up from the body plan and set up in the shear plan, will give their shape; the distance they fall inside of each other, gives the amount of bevel set off from a square in the distance they are apart the same as square frames. It is a common mistake to mould the centre counter timbers too short—not making sufficient allowance in their rake for the crown of the rail.

A mould for the corner counter timber, which is also a stanchion and a chock, is not so readily got. In the body plan the breadth is shown; the shear plan shows the length but not the shape, and it is necessary to expand the heights in the body plan to correspond with the lengths in the shear plan. Draw, say three, parallel lines in the body and shear plans, between the knuckle and plankshear heights. The distance that these lines are apart, measured on the rake in the shear plan, must be set up in the body plan, as also the plankshear height and the length of the stanchion. The breadths squared np to these new heights in the body plan will give a mould for the after side. A mould made to the end of the transom will give the forward side. A new section line near the outer end of the transom will show the bevel and thickness of the chock at that point. By making a filling in piece to the shape of the counter timber that the chock end butts against, and another at the new section, and tacking the fore and aft mould to these pieces, will give all that is required except the bevel of the stanchion, which is got by striking the forward side into the shear plan, squaring down to the half breadth, running it into the body plan, and the distance that it falls inside or outside must be added or diminished from the bevel, which is taken in the same way as the other counter timbers, and applied to the after side. If the after stanchions and corner counter timber are not straight on the out-board side, it will be necessary to draw lines across and square up as before. If there is a twist in the counter it will be shown by the counter timbers not being parallel to each other.

MOULDED SIZE OF FRAMES.

To get the moulded breadth of the frames, we shall do better if we work from a straight line instead of a curve. Bend a batten to the dead flat frame, mark it at the side line, diagonals, plankshear and rail; then take it up and lay it to the base or other straight line. Set off the moulded size of the timber at the side line, floor head, bilge, and other points above; apply a batten to the settings off and make a fair line, then take off the width at each point on a short piece of batten, to be used as a size-stick to apply at each point in sweeping out the inside of the moulds. By using a stick we are less liable to make mistakes than by setting off the widths in inches and eighths.

CUTTING DOWN LINE.

The cutting down line is a line for the top or throat of the floor timbers; it is the lower side of the keelson and upper side of the dead-wood, (unless we want to keep the dead-wood high enough to receive the ceiling). When the dead rise increase so that the frame lines rise much on the side line, as say frame ten in the body plan, the depth of the floors also increases, or there would not be room for the keelson. By applying the size-stick at right angles to the frames in the body plan at the side line, we find how high the throat of the floors must be; but the size of the floors at the lower diagonals do not need to be so large as we approach the ends of the vessel. Whatever depth of floor we determine on, the heights on the side line at every fourth frame must be taken and set up from the base in the shear plan and made to a fair curve. These heights are taken off on a batten and marked on the floor mould. They are fixed points on the side line in sweeping out the inside of the moulds instead of using the size-stick at the lower diagonals.

THE KEEL.

The top of the keel is sometimes made to rise with the bearding; in that case the moulds do not come below the point where the frame lines cross the side line, consequently the heels of all the floors are the full width of the keel, and we can cut a seat say half an inch deep in each floor. It is useful in placing the floor to the centre of the keel and holding there till it is fastened. The rise of the keel causes a fraction of bevel on some of the forward and after frames. The planking will come down to the same point; in either case, the only difference is in leaving the wood on the top of the keel that would otherwise be on the heels of the floors.

WIDTHS OF PLANKING SET OFF ON THE FLOOR.

We may, if we choose, before we leave the floor, run the widths of the planking into the body plan. First set off the widths of the planking on the dead-flat frame, at every third or fourth plank, or at the points where the planking widths change; then (working by a scale) transfer those settings off to the model. By applying a thin flat batten to the model we find which strake it is that will come up to the cross seam. Determine on a point for the same strake on the stem, apply a batten and pencil it in. We may now take two other frames that are about halfway between the centre of the vessel and the two ends, and divide off the planking widths there also. If we do not keep exactly to these points, they will be at least of some service. Divide off the widths on the stem and the stern, apply a batten and pencil in. The heights that these lines are from the water line on the model are transferred back to the floor at such frames as they are taken from, and a curve passed through. If we have not penciled them correctly on the model, we shall readily discover it in the body plan (see plate 2, where the planking widths are run in.)

RISING KEEL AND ROUND STERN.

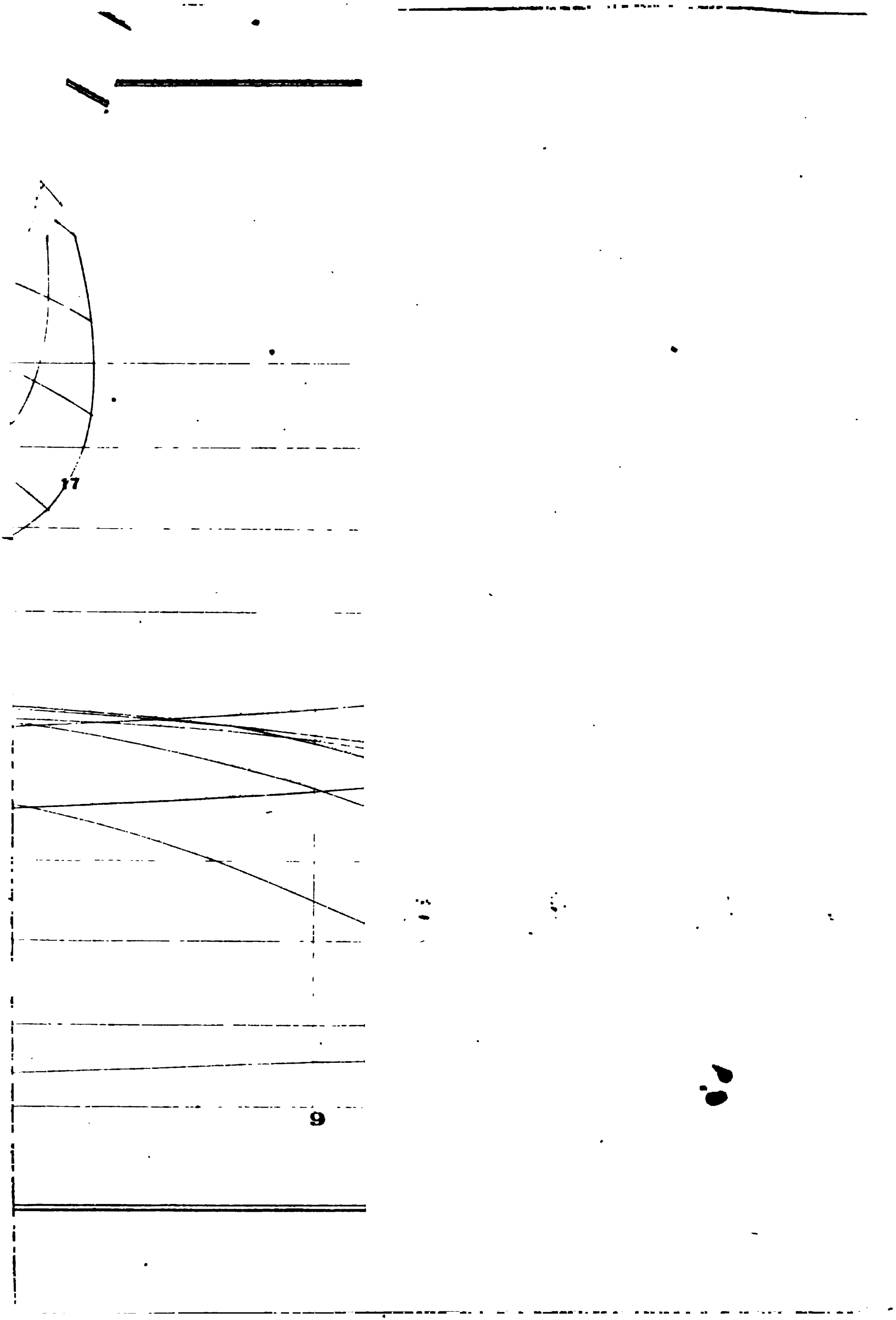
In Plate No. 2 are the lines of a vessel of this description. Whatever rise there may be to the keel, it is set up from the base line in the shear plan, made to a true curve, and the heights at each frame set up from the base in the body plan, giving a separate ending for each.

The principal difference in laying down a vessel with a round from a square stern is in the knuckle height. It must be run into the shear, body, and half breadth plans, and it will rise with the seam in the planking that forms the knuckle—to which some reference should be made in making the model. As the planking which forms the upper side of the knuckle is beveled to form a mitre for the lower planking to butt against. It will be necessary to keep the knuckle up as much higher as the knuckle will be lower when the vessel is planked. If the knuckle is at the plankshear it must be kept up at the centre of the vessel to the crown of the beam. The diagonal lines that cross the knuckle height in the body plan will end on the knuckle in the half breadth plan. The section lines squared up from the half breadth knuckle to the knuckle height, gives the ending for the section lines. A mould for the two centre or counter timbers is got by squaring up into the shear plan; it is a continuation of the bearding line, and as they stand fore and aft the vessel, the half breadth lines show the bevel. Wherever the cants in the half breadth intersect the knuckle, plankshear and rail, those points must be squared up to their corresponding heights, which will be their heights in the body plan. It has been already observed that it is necessary to prove the lines of a vessel all the length, by square frames, though the vessel has a round stern.

OBSERVATIONS ABOUT THE PLATES.

The models from which the lines in the plates are taken, were made to illustrate—if the principle is once understood, it can be applied to any description of model. No more skill is required to draft a vessel of a thousand tons than one of fifty. Everything has been done to avoid confusion.

Only a few of the cants are beveled, but sufficient to show the principle. To have marked the counter timbers in the body and half breadth plans, and run in the shear shear would make confusion in a draft of a quarter of an inch to the foot. In the second plate the diagonals are not run in ; it is only designed to show the rising keel, the round stern, and the planking lines. Shipwrights who have worked in different parts of the country know that the method of doing work varies—the same object is accomplished by different means. The same is true of ship drafting. The points for the setting of masts depend on the form of the vessel. The centre of propulsion is over the centre of displacement ; in other words, the average centre of all the sails must be over the centre of the vessel's carrying capacity, so that if a vessel is full forward or full aft, the masts must be set forward or aft in proportion.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